1863, pp. 293–297. We cannot approve of Dr. Rogers's recommendation that laparotomy, or, as it is more commonly though less correctly called, gastrotomy, should be employed in these cases; a valuable resource in some of the acute cases of obstruction met with in adults, it is, in our opinion, an unsuitable operation in those of intussusception, and particularly when occurring in children. Our reasons for this opinion have been set forth elsewhere, and it is sufficient to add here that the only cases in which, according to Dr. Rogers, the operation has been resorted to among children terminated fatally,[1] while he has himself added another to the already numerous cases of recovery under non-operative treatment.

The succeeding articles in the volume before us consist of obituary or biographical notices of Drs. WILLIAM BURR BIBBINS, EDWARD HALL, ANDREW VAN DYCK, CHARLES BARROWS, JOHN HENRY REYNOLDS, MOSES C. HASBROUCK, and ALFRED E. VARNEY, the writers being respectively Drs. ELLSWORTH ELIOT, A. S. CUMMINGS, J. B. MURDOCH, EDWIN HUTCHINSON, R. S. ALLEN, T. BLANCH SMITH, and C. W. HAMLIN.

Finally come the customary lists of honorary and permanent members, members of the various County Medical Societies of New York, etc.

In conclusion, we may fairly congratulate the members of the New York State Medical Society on the prosperity of their association, and on the general excellence of their published transactions. J. A., JR.

ART. XXXI.—*Ozone and Antozone; their History and Nature; When, Where, Why, How, is Ozone Observed in the Atmosphere?* Illustrated with wood engravings, lithographs, and chromo-lithographs. By CORNELIUS B. FOX, M.D. Edin., M.R.C.P. Lond.; Fellow of the British Meteorological Society, of the Obstetrical Society, etc. pp. xvi., 329. London: J. & A. Churchill, 1873.

FOR many years, though after a somewhat intermittent fashion, men have been endeavouring to fathom the mystery hanging about ozone; and any one who wishes to know what is the present state of our knowledge with regard to this potent agent, cannot do better than read the very complete *résumé* of Dr. Fox. It is difficult to do more than sketch an outline of this work, for, itself a review, and a very good one, of the labours and writings of all the prominent investigators of ozone, it is impossible to condense it. Beginning with a short history of ozone and antozone, the latter of which is now believed to be identical with the peroxide of hydrogen, the author passes to the question "What is ozone?" the answer to which is of great interest, as it is of great importance to those interested in questions of hygiene.

Ozone may be described as a gas which possesses all the oxidizing properties of oxygen, but in a higher degree, and which has, moreover, a pungent odor, and is inimical to life. Ozone will at once oxidize substances which oxygen under ordinary circumstances of temperature will not affect. It is believed to differ from oxygen, of which it is a modification, in that its molecule contains three atoms, while that of oxygen contains but two. This, which was first suggested by Dr. Odling, received what seems to be proof, from experiments of Loret. It appears, from the experiments of Andrews and Tait, that if 100 volumes of oxygen are exposed to the action of electricity, they shrink to about 92 volumes, and about $\frac{1}{12}$ of the oxygen is converted into ozone. If now mercury be exposed to this 92 volumes of ozonized oxygen, the ozone disappears, and yet 92 volumes of oxygen are left. If without the introduction of mercury the ozonized oxygen be heated, the 92 volumes are restored to their original volume—100 volumes, for ozone by heat is converted into ordinary oxygen.

---

[1] A successful operation in a child has been recently reported by Mr. Hutchinson—*Lancet*, Nov. 15, 1873.

"To render Dr. Odling's theory of ozone intelligible, a knowledge of the accepted theoretical conception amongst chemists of the nature of gases is necessary.

"Every gas consists of excessively minute indivisible particles called *atoms*, which, by their aggregation, form *molecules*. The molecules of all gases, whether elementary or compound, have an equal size, and, at the same temperature and pressure, a given volume contains always the same number of them. . . . The formula of oxygen (molecular formula) being now considered by chemists to be O_2, Dr. Odling thinks that the molecule of ozone contains three atoms of oxygen, and that its formation simply means the condensation of oxygen into two-thirds of its former volume. This theory would represent the formula for ozone as O_3 or O_2O, and would attribute its oxidizing power to the ease with which each molecule loses its third atom of oxygen. According to this view, Andrews' and Taits' results become easily comprehensible. 100 cubic inches of oxygen yield 92 cubic inches of ozonized oxygen, because 8 cubic inches coalesce with 16 cubic inches to form 16 cubic inches of ozone. If the gas is heated, the original volume is restored, because the 16 cubic inches of ozone (O_3) yield 24 cubic inches of oxygen (O_2).

"When the ozone is absorbed by the mercury, it is only the third atom which is combined with the mercury; the 16 cubic inches of ozone, therefore, become 16 cubic inches of oxygen, and the volume remains unaltered. . . . . . . This beautiful hypothesis, however, must have remained a mere hypothesis, but for the remarkable experimental verification which it has received from the hands of M. Loret. He has discovered that, whereas most substances only remove the third atom of oxygen from ozone, oil of turpentine is capable of removing *the whole molecule*. If the 92 cubic inches of ozonized oxygen are treated with oil of turpentine instead of with mercury, a white cloud is produced, and the residual oxygen is found to occupy a volume of only 76 cubic inches. The only possible explanation here is, that the 92 cubic inches consisted of 16 of ozone (O_3), and 76 of unaltered oxygen (O_2), and that the former was seized upon entire and removed in the solid form by the oil of turpentine."

This is certainly a most beautiful proof of a very ingenious theory, and it is worthy of remark that, as Dr. Fox says later, "if the differences between ozone and its parent oxygen are great, they are not more if so striking, as are those between the three allotropic modifications of carbon, viz., lampblack, graphite or plumbago, and the diamond" with which we are familiar.

It must not be supposed that Dr. Fox at all passes over any of the opinions which have been expressed with regard to the nature of ozone. All those of any importance he has presented, and, indeed, throughout the work this plan has been almost too fully carried out. It is not unfrequently difficult to eliminate what has been disproved from the results of the most recent investigation.

The author next describes the more common forms of apparatus for the production of ozone, all of which depend upon the action of electricity, and then devotes some pages to the consideration of antozone, which is believed, as has been said, to be indentical with the peroxide of hydrogen. Next we find the question "Does the atmosphere contain ozone?" This is answered in the affirmative. So much electrical disturbance is constantly occurring, as are also slow oxidation and other factors of ozone, that these taken with the fact that there is something in the atmosphere which affects tests as ozone does, would give us great reason for belief in its presence there. In addition, Houzeau, whose work for a while was neglected, but has recently been confirmed, has shown that nothing but ozone can affect one of the tests as this atmospheric agent does.

The atmosphere does contain peroxide of hydrogen, which was for awhile believed to be antozone, or another allotropic state of oxygen. This is the next point mentioned.

We now come to the "When, Where, Why, How?" which have so prominent a place in the title.

Each of these is subdivided, and we get "When has ozone been observed in the atmosphere?" and "When should ozone be observed?" etc., and so for the Where, How, and Why? a peculiar arrangement, but one which perhaps answers the author's purpose of a detailed treatment of the subject.

Ozone appears to be constantly present in all pure air. It is not found when the air is foul, and this is probably because it is consumed as fast as it is produced. It is found in larger quantity during the winter and spring months than in the summer and autumn—by night than in the daytime.

It should be observed constantly, as the variation in amount from hour to hour is great.

Where.—It is observed on the weather side of cities, little being observed on the side to which the wind is blowing. It is rarely found in cities, probably on account of the immense quantity of oxidizable material to be met in them and the air of the streets. It is especially abundant in the air fresh from the sea; for the ocean is a great ozone maker. The atmosphere of the pine forests has also more than its share. In this connection it is not uninteresting to notice that many dried herbs, as well as certain substances used as perfumes, millefleurs, for example, produce ozone, and it may be that the good effect thought to be produced by the placing of dried herbs between the prisoners' dock and the court, and by lavender among linen, was more real than we have imagined, and due to ozone.

It *should* be observed everywhere, so as to add to our information on the subject, which though extensive is vague.

Why.—In order to settle the question as to the part played by ozone, it has been and should be looked for and observed when found. There seems little doubt that we have in it a most valuable means for the destruction of much that is recognized as deleterious to man. We cannot as yet say whether or no there is any connection between the rise and fall of certain epidemics and the increase and decrease in the amount of ozone in the atmosphere. Observers differ. Some report an increase in the amount of ozone at the very time that epidemics were gaining strength. Others have obtained opposite results. Many are disposed to attribute epidemics of influenza to an excess of ozone. With regard to all this we need many more, and very careful, observations, and much time and labour must be spent before any conclusion at all satisfactory can be arrived at.

Ozone certainly is a powerful oxidizer. This much we know, and all deleterious matter which becomes innoxious when oxidized must yield to it; but for a knowledge of the rest we must wait and work.

Dr. Fox passes in review the so-called *practical* uses of ozone, such as bleaching, in order that as many labourers as possible may be called into the field; a very cheap way of making ozone being among the desiderata.

That portion of the work headed "How" takes up nearly half the book, and is important.

The means necessary to the proper recording of the amount of ozone in the atmosphere are a test and a receptacle for it, called usually an "ozone box."

The box should be so contrived that while free access of air is allowed rain is excluded, and the force of the wind somewhat moderated before it reaches the interior. In fact, where circumstances allow of it, it is best to draw a known amount of air through the box containing the test at a known rate by means of an aspirator—a convenient form of the latter being a modification of Bunsen's filter pump.

As tests various substances have been employed—most commonly, however, iodide of potassium, alone or in combination, has been used, as this salt is readily decomposed by ozone.

Schœnbein used a test containing iodide of potassium and starch which gave a blue colour of an intensity corresponding to the amount of iodine liberated when the ozone attacked the potassium. For various reasons, however, this test has been given up by many observers, and the two recommended by Dr. Fox are: the iodized litmus test and the iodide of potassium test. In the first of these, Houzeau's, which is composed of slightly reddened litmus and iodide of potassium, the ozone attacks the iodide, liberating the potassium, which, as potash, turns the red litmus blue, more or less, according to the intensity of the action. In the other the ozone liberates the iodine, which may either remain free or form iodate of potassium with the ozone and the potassium, which it has just left. In this latter case the iodine colour, on which the test depends, does not make its appearance until the surface of the test paper has been sprayed with a solution of tartaric acid, which, liberating both iodic and hydriodic acids, causes them to react with one another and the iodine to make its appearance.

Both these tests are exposed to the atmosphere on the surface of slips of paper, and for this purpose Swedish filtering paper of good quality has been found by Dr. Fox to be the best.

It is of the greatest importance that the iodide of potassium should be chemically pure, and the test papers should be freshly prepared as often as possible.

Dr. Fox concludes by making the following suggestions:—

"The prevention of disease being *the* great end and aim of the medical art, how important is it that *savants* should fully investigate the amount and functions in the air of these active agents. A thoroughly accurate estimation of the amount of ozone present in the pure air of different climates, and, during the various atmospheric conditions of each climate, should first be obtained. Being possessed of this information we shall be in a position to attempt an elucidation of the following and many other questions which are of immense interest and importance to the human race:—

"1. What are *all* the sources of atmospheric ozone?

"2. How is it formed, and in what circumstances does it arise?

"3. What is its precise action on animals and plants?

"4. Has an excess or deficiency of ozone any effect on the public health?

"5. If so, what is the nature of that influence?

"6. What is the effect of the presence of epidemics on its amount as calculated by the improved ozonometric method?

"7. Does ozone oxidize one only or all of the different kinds of organic matter found in the air?"

This is a formidable array of questions, but the information asked for is of undoubted value. We trust that Dr. Fox's exertion in the direction of improved methods may reap its reward in an increase of the number of observers and of accuracy in their observations. H. B. H.